

A Braking Device For An Industrial Truck

5 CROSS-REFERENCE TO RELATED APPLICATIONS

Not applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

Not applicable.

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BACKGROUND OF THE INVENTION

It is known to brake at least one wheel of an industrial truck by means of a hydraulic brake. A hydraulic braking device usually includes a hydraulic brake cylinder actuated by a brake pedal that is connected to at least one brake on a wheel
15 via a brake line. Via the brake line, a brake piston is supplied with a pressure in order that brake shoes or brake blocks can get into engagement with a brake drum or brake disc.

It is known to equip industrial trucks and also other vehicles with an electric steering mechanism. In an electric steering mechanism, there is no direct mechanical
20 connection between a steering element such as a steering wheel, and the steered wheel. Rather, the deflection of a steering element is detected and is electrically transmitted to an electric steering actuator which adjusts the steered wheel to the steering angle desired. It cannot be ruled out that such steering mechanisms can no longer be steered if a power failure or another trouble occurs. For this case, it should
25 be made sure that the vehicle be braked in a controlled manner.

It is the object of the invention to provide a braking device for industrial trucks by means of which the vehicle can be automatically braked if a malfunction of vehicle operation occurs, independently of the usual braking action.

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BRIEF SUMMARY OF THE INVENTION

In the inventive braking device, the brake line has connected thereto a further hydraulic brake cylinder which, when actuated, also causes a braking procedure. Further, this brake cylinder has associated therewith an electromagnet to actuate the
5 second brake cylinder. If there is a malfunction, e.g. a power failure, in the vehicle an emergency stop device generates an actuation signal for the electromagnet which, as a result, actuates the second brake cylinder.

The invention utilizes the existing hydraulic braking system as the second
10 brake cylinder is also connected to the brake line. Hence, actuating the second brake cylinder will result in a braking procedure as is also effected when the operator actuates the brake pedal. On the other hand, however, the second brake cylinder or its actuation is severed from the common brake actuation because the braking procedure and the braking effect are initiated by an actuation of an electromagnet.

The inventive braking device requires little constructional space and few
15 components for the so-called emergency stop braking procedure.

According to an aspect of the invention, the first and second brake cylinders are connected to the brake line via a shuttle valve. Actuating only one brake cylinder causes the valve member of the shuttle valve to be shifted so that the passage is opened to the brake line. At the same time, the flow line is closed to the second
20 brake cylinder. If the two brake cylinders are actuated simultaneously the braking procedure is carried out by that brake cylinder to which the larger force is applied.

According to another aspect of the invention, the electromagnet is acted on by a spring which is tensioned when the electromagnet is energized. When the electromagnet is de-excited or de-energized the result is that the second brake
25 cylinder is actuated accordingly.

Various constructional approaches are imaginable to actuate the second brake cylinder by means of the electromagnet. According to the invention, one thereof pro-vides that the electromagnet is coupled to the second brake cylinder via a lever linkage. To realize the lever linkage, a further aspect of the invention

provides that the electromagnet acts upon a first rod which is hinged to a lever at a first pivot point while the second brake cylinder is hinged to a lever at a second pivot point. More-over, the lever is stationarily supported at a third pivot point with the second pivot point located between the first and third pivot points. This actuates
5 the brake cylinder when the electromagnet pivots the lever.

The third pivot point may also be formed by a rod which stationarily supports the lever in the direction of pull. The rod can shift itself in the opposite direction.

According to a further aspect of the invention, a joint mounting can be
10 provided for the second brake cylinder, the electromagnet and the lever linkage. According to a further aspect of the invention, the mounting may be defined by a plate with the second brake cylinder and the electromagnet disposed on one side of the retaining plate and the lever linkage disposed on the other side of the retaining plate.

15 The pivot points for the electromagnet and brake cylinder and the stationary support may be adjustable to vary the kinematics.

BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE INVENTION

The invention will be described in more detail below with reference to an
20 embodiment shown in the drawings.

Fig. 1 schematically shows a braking system for an industrial truck having features of the invention.

Fig. 2 shows an emergency stop device according to the invention.

25 DETAILED DESCRIPTION OF THE INVENTION

While this invention may be embodied in many different forms, there are described in detail herein a specific preferred embodiment of the invention. This description is an exemplification of the principles of the invention and is not intended to limit the invention to the particular embodiment illustrated.

In Fig. 1, four wheels 10, 12, 14, 16 of an industrial truck which is not shown in detail are outlined. A hydraulically actuated brake which is not shown either is disposed on each of the wheels 10 to 16. The brakes are connected to a braking
 5 device generally designated 20 via a brake line 18. The braking device contains a first brake cylinder 22 which is connected to the brake line 18 via a shuttle valve 24. Further, a second brake cylinder 26 is provided which is also connected to the brake line 18 via the shuttle valve 24. The brake cylinders 22, 26 are in communication with a pressure equalization vessel 30 via a joint line 28.

10 The brake cylinder 22 is actuated by a brake pedal, which is not shown, of the industrial truck. The way of actuating the second brake cylinder 26 is apparent from Fig. 2.

In Fig. 2, a retaining plate 32 can be seen which can be mounted at an appropriate place in the industrial truck by means of a flange 34. The brake cylinder
 15 26 is mounted on one side of the retaining plate 32. Its piston rod extends through an opening of the retaining plate 32. The piston rod indicated by 36 is connected to a lever 42 in a pivot point 40 via a bifurcated element 38.

A lifting magnet 44 is connected to the retaining plate 32 on the same side. It is biased by a spring 44. The armature of the lifting magnet 44 has connected thereto a
 20 rod 46 which is connected to the lever 42 at the pivot point 50 via a bifurcated element 48. The pivot point 50 is located at the lower end (Fig. 2) of the lever 42. A third pivot point 52 is located at the other end of the lever 42 and is connected, via a bifurcated element 54, to a rod 56 which extends through an opening of the retaining plate 32. A stop 58 is mounted on the rod 56 on the other side of the retaining plate
 25 so that the rod 56, while moving to the right, is supported on the plate 32, but is capable of moving to the left through the opening of the retaining plate 32.

When the lifting magnet 44 is excited the rod 46 is fully extracted and the spring 44 is tensioned. The brake cylinder 26 is relieved of stress. In a de-energized condition, the electromagnet becomes de-excited and the rod 46 is retracted by the

restoring spring 44. This causes the rod 36 to be actuated when the lever 42 is pivoted in a clockwise sense, and so is the brake cylinder 26 which actuates the brakes on the wheels 10 to 16, as a result.

5 The rods 56 and 46 engage the lever 42 via the bifurcated elements 54, 48 and can be fixed by means of a bolted joint by which it is very possible to hinge them, but not to effect a relative displacement. However, they can be displaced by loosening the bolted joint so that the lengths of engagement can be varied on the rods 56, 46. This is generally the case also for the rod 36 and the bifurcated element 38. Thus, it allows to set the kinematics desired for an actuation of the second brake
10 cylinder 26. Once the setting is made, however, it will fix the braking characteristic which is imposed by means of the second brake cylinder.

The signal for de-exciting the electromagnet 44 can be generated by an emergency stop device which is not shown. It ascertains whether there is a malfunction or power failure.

15 The above disclosure is intended to be illustrative and not exhaustive. This description will suggest many variations and alternatives to one of ordinary skill in this art. All these alternatives and variations are intended to be included within the scope of the claims where the term "comprising" means "including, but not limited to". Those familiar with the art may recognize other equivalents to the specific
20 embodiments described herein which equivalents are also intended to be encompassed by the claims.

Further, the particular features presented in the dependent claims can be combined with each other in other manners within the scope of the invention such that the invention should be recognized as also specifically directed to other
25 embodiments having any other possible combination of the features of the dependent claims. For instance, for purposes of claim publication, any dependent claim which follows should be taken as alternatively written in a multiple dependent form from all prior claims which possess all antecedents referenced in such dependent claim if such multiple dependent format is an accepted format within the

jurisdiction (e.g. each claim depending directly from claim 1 should be alternatively taken as depending from all previous claims). In jurisdictions where multiple dependent claim formats are restricted, the following dependent claims should each be also taken as alternatively written in each singly dependent claim format which
5 creates a dependency from a prior antecedent-possessing claim other than the specific claim listed in such dependent claim below.

This completes the description of the preferred and alternate embodiments of the invention. Those skilled in the art may recognize other equivalents to the specific embodiment described herein which equivalents are intended to be
10 encompassed by the claims attached hereto.

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